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Tortoise beetles of Rawalpindi-Islamabad, Pakistan and their host preferences (Coleoptera: Chrysomelidae: Cassidinae)

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ABSTRACT. Twelve Cassidinae species were observed in Rawalpindi and Islamabad areas, Pakistan. Food plant association of collected species has been studied. New hosts are provided for *Cassida exilis* BOH., *C. nigirventris* BOH., *C. varians* HERBST, *Glyphocassis trilineata* (HOPE), *Laccoptera nepalensis* BOH., *Notosacantha* cf. *jammuensis*, and *Oocassida pudibunda* BOH. The family Betulaceae is a new host family for true cassidine beetles.

Key words: entomology, bionomy, distribution, Coleoptera, Chrysomelidae, Cassidinae, host plants, new records, Rawalpindi, Islamabad, Pakistan.

INTRODUCTION

Tortoise beetles belong to subfamily Cassidinae, which is a part of the large family Chrysomelidae (leaf beetles) and are characterized by rotundate shape with a prolongation of prothorax and expansion of elytra in the form of explanate margins all round. Explanate margin of prothorax conceals the head when viewed dorsally while the legs are also invisible when the insect is resting owing to explanate margins of elytra. However in some genera the head is exposed due to an emargination or longitudinal split in the middle of the front edge of the prothorax. Deviations in shape from oval body form include oblong or quadrate shapes in some genera. Live specimens are often brilliantly coloured with metallic iridescence. Larvae are usually exophagous (except the tribe Notosacanthini) and bear a caudal appendage that carries exuvia usually impregnated with faeces.

While most of cassidine species feed on obnoxious weeds some are important pests. Reported pests of sweet potato (*Ipomoea batatas* (L.) LAM.) include species like *Aspidomorpha miliaris* FAB. (GRESSITT 1952; MANJUNATHA et al. 1986; MAULIK 1919), *A. indica* BOH. (FLETCHER 1919), *Glyphocassis trilineata* HOPE (KALAICHELVAN et al. 2004; VARMA 1954), *Cassida circumdata* HERBST (VARMA 1954) and *Cassida indicola* DUV. (VARMA 1954).

Work by MAULIK (1919) continues to be the most comprehensive account of cassidine fauna of the sub-continent. World Catalogue of the Cassidinae by BOROWIEC (1999) lists 2760 species and is also available in the form of an interactive manual on the web giving the synonymies, distribution, host plants, published literature and colour photographs for most of the species (BOROWIEC & ŚWIĘTOJAŃSKA 2008).

There have been few records of cassidine beetles occurring in Pakistan by various workers mostly conducting broader faunistic surveys in order to document insect species associated with forests and weed species. CHAUDHRY et al. (1966) surveyed the insect fauna of forests of Pakistan and reported *Cassida pagana* BOH. (probably misidentification) and *Hoplionota* sp. (now *Notosacantha* sp.), while *Aspidomorpha indica* BOH., *Cassida nigriventris* BOH., *C. subtilis* WEISE, *Glyphocassis trilineata* (HOPE) and *Hoplionota* sp. were later recorded by CHAUDHRY et al. (1970).

ALAM et al. (1969) surveyed insects destroying weeds and reported five cassidine species from Pakistan on different weed hosts viz., *Cassida exilis* BOH., *C.* (now *Rhytidocassis*) *indicola* DUVIV., *C. nigriventris* BOH., *C. syrtica* BOH. (= *C. varians* HERBST) and *Glyphocassis trilineata* (HOPE).

ABDULLAH and QURESHI (1969) compiled key characters for identification of Pakistani genera and species based on MAULIK (1919). They keyed out the characters for 8 species viz., *Epistictina viridimaculata* (BOH.), *Hoplionota* (now *Notosacantha*) *maculipennis* BOH., *Lacoptera quadrimaculata* (THUNBERG) (= *L. nepalensis* BOH.), *Oocassida pudibunda* (BOH.), *Cassida pusillula* BOH. (= *C. obtusata* BOH.), *C. icterica* BOH., *C. syrtica* BOH. (= *C. varians* Herbst) and *C. catenata* (BOH.), however, their paper lacks distribution records for these species.

BALOGH (1974) reported 6 species of cassidine beetles on *Convolvulus* spp. from different areas of Pakistan viz., *Aspidomorpha indica* BOH., *Cassida enervis* BOH. (probably misidentification), *C.* (now *Rhytidocassis*) *indicola* DUV., *Glyphocassis trilineata* (HOPE), *Metriona* (now *Cassida*) *australica* BOH. and *Taiwania* (now *Cassida*) *circumdata* HERBST.

METHODS

Different localities in the districts Rawalpindi and Islamabad were surveyed for collection of cassidine beetles and their host plants during the period from June to October in 2005-2007. Infested plants are recognizable because of typical feeding pattern marked by usually circular holes on leaves. Larvae and adults were searched under such leaves. Foliage harbouring the larvae of cassidine species were collected and brought to laboratory for rearing of larvae on their respective hosts in screened wooden cages measuring 5" x 5" x 5". Fresh foliage was provided every other day until

the larvae pupated so that they could be identified when adults emerge from pupae. Identification of host plants was carried out by consulting different volumes of Flora of Pakistan (KAISAR and NAZIMUDDIN 1981; TOWNSEND 1974; AUSTIN and GHAZANFAR 1979; HEDGE 1990).

RESULTS AND DISCUSSION

Beetles collected and identified by the authors during the current studies comprise 12 species. Species like *Cassida nigirventris* BOH., *C. exilis* BOH. and *Glyphocassis trilineata* HOPE were common in anthropogenic sites feeding on obnoxious weeds; highlighting their potential importance as bio-control agents for managing weed populations. However in addition to weed hosts *G. trilineata* HOPE was found feeding on leaves of ornamental sweet potato (*Ipomoea batatas*) and similarly *C. exilis* BOH. was collected from the foliage of Cockscomb (*Celosia cristata*), an ornamental commonly grown for brightly coloured inflorescences. *C. circumdata* HERBST was found feeding on leaves of Railway Creeper (*Ipomoea cairica*). *C. varians* HERBST was restricted to relatively undisturbed pine forests in hilly areas. Whereas *Aspidomorpha indica* BOH., *A. miliaris* F., *Lacoptera nepalensis* BOH., *Oocassida cruenta* (F.), *O. pudibunda* BOH., and *Notosacantha* cf. *jammuensis* were recorded from undisturbed suburbs.

This study reports new host plants for *Lacoptera nepalensis* BOH., *Cassida exilis* BOH., *C. nigirventris* BOH., *C. varians* HERBST, *Glyphocassis trilineata* (HOPE), *Oocassida pudibunda* (BOH.) and *Notosacantha* cf. *jammuensis*. *Aspidomorpha miliaris* F., *C. varians* HERBST, *Oocassida cruenta* (F.), *O. pudibunda* BOH. and *Notosacantha* cf. *jammuensis* were restricted to one plant species while *Cassida circumdata* HERBST, *Lacoptera nepalensis* BOH., *G. trilineata* (HOPE) exploit different members of Convolvulaceae as host plants. *Cassida nigirventris* BOH. utilizes members of two related plant families (Amaranthaceae and Chenopodiaceae) as food plants while *C. exilis* BOH. seems to exploit a wider host range (Table 1).

LIST OF SPECIES

Tribe: Cassidini

1. *Cassida circumdata* HERBST, 1799

Host plants: Adults and larvae of this species were found feeding on the foliage of *Ipomoea aquatica* and *I. cairica* (Convolvulaceae).

Previous host plant record for this species is Convolvulaceae: *Ipomoea batatas*, *I. reptans*, *Ipomoea purpurea*, *I. heteracea*, *I. cairica* (YEUNG 1934); *Ipomoea palmata*, *I. batatas*, *I. aquatica*, *I. cairica*, *I. digitata* (GRESSITT 1952); *Calystegia soldanella*, *Ipomoea batatas* (CHÛJÔ and KIMOTO 1961); *Ipomoea indica* (TAKIZAWA 1975); *Calystegia* sp. (TAKIZAWA 1978); *Ipomoea* sp. (MEDVEDEV and DAN 1982; MEDVEDEV and EROSHKINA 1982; REID 1998); *Ipomoea reptans* (JOHN GEORGE and VENKATARAMAN

1986); *Ipomoea aquatica*, *I. sp.* (GHATE et al. 2003); *Convolvulus nummularis*, *Ipomoea aquatica*, *I. batatas*, *I. fistulosa*, *I. palmata*, *I. violacea*, *Merremia emarginata* (KALAICHELVAN et al. 2004).

Distribution: Bangladesh; Caroline Is., Ceylon, S China, India, Indonesia, Japan (Kyushu, Ryukyu), Laos, Malaysia (continental and Sarawak), Nepal, Philippines, Thailand, Taiwan, and Vietnam. Introduced and established to Hawaii. Now from Pakistan it was collected on March 2007 from Sajawal near Thatta in Sindh Province and on September 2007 in Islamabad.

2. *Cassida varians* HERBST, 1799

Host plants: Adults and larvae of this species were found feeding on the foliage of *Anisomeles indica* (Lamiaceae) and this is new host plant record for this species.

Previous host plant record for this species is Lamiaceae: *Leucas linifolia* (GHATE et al. 2003).

Distribution: Burma, Bhutan, India, and Nepal and now from Pakistan where this species was collected in Margalla Hills (Islamabad) during the months of July-August.

3. *Cassida exilis* BOHEMAN, 1854

Host plants: Adults and larvae of this species were found feeding on the foliage of *Amaranthus viridis* (Amaranthaceae), *Celosia cristata* (Amaranthaceae) and *Digera muricata* (Amaranthaceae). One adult was also collected from foliage of *Ziziphus jujuba* (Rhamnaceae) in District Sialkot of Punjab. These are new host plant records for this species.

Previous host plant records for this species are Chenopodiaceae: *Chenopodium viridis*; Lamiaceae: *Salvia moorcroftiana*; Rhamnaceae: *Ziziphus mauritiana*; Rosaceae: *Prunus bokhariensis*; Rutaceae: *Citrus* spp. (ALAM et al. 1969); Amaranthaceae: *Alternanthera sessilis*, *Amaranthus paniculatus*, *Achyranthes aspera* (GHATE et al. 2003); *Alternanthera sessilis*, *A. tenella*, *Amaranthus blitum*, *A. philoxeroides*, *A. simplex*, *Celosia argentea* (KALAICHELVAN et al. 2004); Meliaceae: *Milingtonia hortensis* (KALAICHELVAN et al. 2004); Lamiaceae: *Leucas lanata* (TAKIZAWA 1980). Records from families other than Chenopodiaceae and Amaranthaceae based probably only on additional host for adults.

Distribution: India (Bengal, Bombay, Haryana, Madhya Pradesh, Madras, Maharashtra, Tamil Nadu) and now from Pakistan where this species was collected in Rawalpindi, Islamabad (during July-August) and Sialkot (during January).

4. *Cassida nigriventris* BOHEMAN, 1854

Host plants: Adults and larvae of this species were found feeding on the foliage of *Achyranthes* sp. (Amaranthaceae), *Alternanthera pungens* (Amaranthaceae) and on *Chenopodium* sp. (Chenopodiaceae). *A. pungens* being the preferred host. These are new host plant records for this species.

Previous host plant records for this species are Amaranthaceae: *Amaranthus spinosus*, *A. viridis* and *A. hybridus* (BALOCH et al. 1977); Oleaceae: *Olea cuspidata*, Malvaceae: *Hibiscus mutabilis*, Araliaceae: *Hedera nepalensis* and Acanthaceae: *Adhatoda vasica* (ALAM et al. 1969); Rutaceae: *Citrus* sp. and Rosaceae: *Prunus padus* (CHAUDHRY et al. 1970). It is doubtful that *Citrus* sp. and *Prunus padus* may serve as food plants for *C. nigriventris* as it was found feeding on *Amaranthus* spp. by BALOCH et al. 1977 and the present observations also show that plants belonging to families Amaranthaceae and Chenopodiaceae are hosts for *C. nigriventris*. Moreover records from Acanthaceae, Araliaceae, Malvaceae, Oleaceae, Rosaceae, and Rutaceae need to be verified or based on additional hosts for adults.

Distribution: Bhutan, China (Guangxi, Yunnan, Xizang), India (Punjab, Uttar Pradesh, Sikkim), Nepal, Thailand, Vietnam, and now from Pakistan where this species was collected in Margalla Hills (Islamabad) during July-August.

5. *Glyphocassis trilineata* HOPE, 1831

Host plants: Adults and larvae of this species were found feeding on the foliage of *Ipomoea nil*, *I. eriocarpa*, *I. batatas* and *Convolvulus arvensis* (Convolvulaceae). *Ipomoea nil* and *I. eriocarpa* are new host records for this species.

Previous host plant records for this species are Convolvulaceae: *Convolvulus arvensis*, *Ipomoea purpurea* (BALOCH 1974); *Ipomoea hederacea*, *Ipomoea* sp. (ALAM et al. 1969); *Ipomoea* sp. (MEDVEDEV 1983; TAKIZAWA 1985); *Convolvulus nummularius*, *Ipomoea aquatica*, *I. batatas*, *I. fistulosa*, *I. hispida*, *I. indica*, *I. obscura*, *I. palmata*, *I. pestigridis*, *I. pilosa*, *I. violacea*, *Merremia emarginata* and *M. tridentata* (KALAICHELVAN et al. 2004) and Rosaceae: *Malus pumila* (ALAM et al. 1969). Record of *Malus pumila* (Rosaceae) as host for *G. trilineata* HOPE by ALAM et al. (1969) needs further verification.

Distribution: Nepal; China: eastern Szechuan Province, North of Chungking, Pe-pei, Guangxi, Sichuan, Yunnan; India: Bengal, Sikkim; Laos; Nepal; Thailand; Vietnam and now from Pakistan where this species was collected in Margalla Hills, Rawal Dam (Islamabad) during July-August, Abbottabad (during August) and Kaghan (during June).

6. *Oocassida cruenta* (FABRICIUS, 1792)

Host Plants: Adults and larvae of this species were found feeding on the foliage of *Ziziphus nummularia* (Rhamnaceae).

Previous host plant records for this species is Rhamnaceae: *Ziziphus nummularia* (TAKIZAWA 1985).

Distribution: Bangladesh; India: Orissa, Pondicherry, Tamil Nadu, West Bengal, Nepal; and now from Pakistan where this species was collected in Islamabad during May.

7. *Oocassida pudibunda* (BOHEMAN, 1856)

Host Plants: Adults and larvae of this species were found feeding on the foliage of *Ziziphus nummularia* (Rhamnaceae). This is new host plant record for this species.

Previous host plant records for this species is Rhamnaceae: *Ziziphus jujuba* (= *Z. mauritiana*) (GHATE et al. 2003).

Distribution: India: Bengal, Bihar, Maharashtra, Orissa, Uttar Pradesh, United Provinces, Central Provinces; Nepal and now from Pakistan this species was collected from Islamabad during August.

Table 1: Host plants recorded in the present study

Plant Name	Host for	Host plant status
Family: Amaranthaceae		
<i>Achyranthes</i> sp.	<i>Cassida nigriventris</i> BOH.	New host plant record
<i>Alternanthera pungens</i> KUNTH	<i>Cassida nigriventris</i> BOH.	New host plant record
<i>Amaranthus viridis</i> L.	<i>Cassida exilis</i> BOH.	New host plant record
<i>Celosia cristata</i> L.	<i>Cassida exilis</i> BOH.	New host plant record
<i>Digera muricata</i> (L.) MART.	<i>Cassida exilis</i> BOH.	New host plant record
Family: Betulaceae		
<i>Alnus nitida</i> (SPACH) ENDL.	<i>Notsacantha</i> cf. <i>jammuensis</i>	New host plant record
Family: Chenopodiaceae		
<i>Chenopodium</i> sp.	<i>Cassida nigriventris</i> BOH.	New host plant record
Family: Convolvulaceae		
<i>Ipomoea nil</i> (L.) ROTH.	<i>Glyphocassis trilineata</i> HOPE	New host plant record
	<i>L. nepalensis</i> BOH.	New host plant record
<i>Ipomoea aquatica</i> FORSSK.	<i>Cassida circumdata</i> HERBST	Present study, GHATE et al. (2003), KALAICHELVAN et al. (2004)
	<i>Rhytidocassis indicola</i> DUV.	Present study, KALAICHELVAN et al. (2004)
<i>Ipomoea cairica</i> (L.) SWEET	<i>Cassida circumdata</i> HERBST	Present study, YEUNG (1934), GRESSITT (1952)
<i>I. eriocarpa</i> R. BR.	<i>Glyphocassis trilineata</i> HOPE	New host plant record
<i>I. batatas</i> (L.) LAM.	<i>Glyphocassis trilineata</i> HOPE	Present study, KALAICHELVAN et al. (2004)
<i>I. carnea</i> JACQ. ssp. <i>fistulosa</i> (MART. ex CHOISY) D. AUSTIN	<i>Laccoptera nepalensis</i> BOH.	New host plant record
<i>I. carnea</i> JACQ. ssp. <i>fistulosa</i> (Mart. ex Choisy) D. AUSTIN	<i>Aspidomorpha miliaris</i> FAB.	Present study, RAMESH (1996); GHATE et al. (2003)
<i>Convolvulus arvensis</i> L.	<i>Glyphocassis trilineata</i> HOPE	Present study, BALOCH (1974)
Family: Lamiaceae (Labiatae)		
<i>Anisomeles indica</i> (L.) O.	<i>Cassida varians</i> HERBST	New host plant record
Family: Rhamnaceae		
<i>Ziziphus nummularia</i> (BURM. f.) WIGHT & ARN.	<i>Oocassida pudibunda</i> BOH.	New host plant record
	<i>Oocassida cruenta</i> F.	Present study, TAKIZAWA (1985)
<i>Ziziphus jujuba</i> MILL.	<i>Cassida exilis</i> BOH.	New host plant record

8. *Rhytidocassis indicola* DUVIVIER, 1892

Host Plants: Adults and larvae were found feeding on the foliage of *Ipomoea aquatica* (Convolvulaceae).

Previous host plant records for this species are Convolvulaceae: *Ipomoea* sp. (GHATE et al. 2003); *Convolvulus nummularius*, *Ipomoea aquatica*, *I. batatas*, *I. fistulosa*, *I. obscura*, *I. palmata*, *I. violacea*, *Merremia emarginata*, *M. tridentata* (KALAICHELVAN et al. 2004).

Distribution: India, Bangladesh and Pakistan. Now it was collected on March 2007 from Sajawal near Thatta in Sindh Province expected to occur in Rawalpindi-Islambad districts.

Tribe: Aspidomorphini

9. *Aspidomorpha miliaris* FABRICIUS, 1775

Adults and larvae of this species were found feeding on the foliage of *Ipomoea carnea* ssp. *fistulosa* (Convolvulaceae).

Previous host plant records for this species are Convolvulaceae: *Calonyction bona-nox*, *Convolvulus* sp., *Ipomoea triloba*, *I. pescaprae*, *I. batatas* (GRESSITT 1952); *Ipomoea* sp. (TAKIZAWA 1980, 1985; MEDVEDEV and DAN 1982); *Ipomoea angulata*, *I. batatas*, *I. palmata* (MANJUNATHA et al. 1986); *Ipomoea carnea*, *I. aquatica* (RAMESH 1996); *Ipomoea carnea*, *I. sp.* (GHATE et al. 2003); *Ipomoea fistulosa*, *I. palmata*, *I. violacea* (KALAICHELVAN et al. 2004).

Distribution: Bangladesh; Burma; China: Guandong, Guangxi, Hainan, Yunnan; Hongkong; India: Madras, Bengal, Sikkim, Assam; Indonesia; Laos; Malaysia; Nepal; New Guinea; Philippines; Thailand; Vietnam and now from Pakistan, where this species was collected in Rawal Dam (Islamabad) during September.

10. *Aspidimorpha indica* BOHEMAN, 1854

Host Plants: Collected on flight, host range comprises of various Convolvulaceae.

Previous host plant records for this species are Convolvulaceae: *Convolvulus arvensis* L. (BALOCH 1974); *Calystegia sepium* var. *japonica* (GRESSITT 1952); *Calystegia japonica* (CHÛJÔ and KIMOTO 1961; KIMOTO and TAKIZAWA 1994); Fabaceae: *Indigofera* sp. (CHAUDHRY et al. 1970) and Ulmaceae: *Celtis* sp. (CHAUDHRY et al. 1970); Acanthaceae: *Adhatoda vasica* (ALAM et al. 1969). Records from Acanthaceae, Fabaceae and Ulmaceae based probably only on additional hosts for adults.

Distribution: Bangladesh, Burma, S China (Sichuan, Yunnan, Xizang), India, Indonesia (Java, Sumatra), Laos, Malaysia, Nepal, Philippines (Palawan) Vietnam, Taiwan, Thailand and now from Pakistan where this species was recorded in Islamabad in October.

11. *Laccoptera nepalensis* BOHEMAN, 1855

Host Plants: Adults and larvae of this species were found feeding on the foliage of *Ipomoea carnea* ssp. *fistulosa* and *I. nil* (Convolvulaceae). These are new host plant records for this species.

Previous host plant records for this species are Convolvulaceae: *Calystegia soldanella* (CHÛJÔ and KIMOTO 1961); *Ipomoea indica* (TAKIZAWA 1975); *Ipomoea* sp. (TAKIZAWA 1978; MEDVEDEV and DAN 1982).

Distribution: Burma, S and E China, India (Madras, Bombay, United Provinces, Bengal, Sikkim, Assam), Indonesia (Java, Sumatra), Japan (Ryukyu Is.), Laos, Malaysia, Nepal, Singapore, Thailand, Vietnam and now from Pakistan where this species was collected in Rawal Dam (Islamabad) during August-September.

Tribe: Notsacanthini

12. *Notosacantha* cf. *jammuensis*

Host Plants: Adults collected in Dadar (Shinkari, district Mansehra) on *Alnus nitida* (Betulaceae) on September 1, 2007; this is a new host plant record for any cassidine beetle.

It was collected earlier by CHAUDHURY et al. (1970) from the same locality and from same host.

Note: specimens collected on *Alnus nitida* are similar to *Notosacantha jammuensis* BOROWIEC et TAKIZAWA, 1913 from NW India, *N. maculipennis* (BOHEMAN, 1856) from N India, Nepal and N Burma, and *N. vicaria* (SPAETH, 1913) from Andaman Is., Ceylon, and India (Maharashtra, Mysore, Tamil Nadu) but belong to a new species. Its description will be published in a separate paper. *Notosacantha vicaria* feeds on Euphorbiaceae: *Glochidion ellipticum* (GHATE et al. 2003) and Rhizophoraceae: *Carallia brachiata* (RANE et al. 2000), host plant of two other congeners is unknown.

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